

REMARKS

In paragraph 1 of the Office Action it is indicated that Applicant's prior arguments have been considered, but are moot in view of new grounds of rejection. Applicant appreciates the Examiner's consideration of Applicant's arguments.

In paragraphs 2 and 3 of the Office Action claims 1-3 are rejected under 35 U.S.C. 102(b) as being anticipated by Roth et al (5,272,117), stating:

"As to claims 1 and 3, Roth et al teach that a plurality of upwardly projecting components(14) are formed on a substrate (12) and a polish-stop layer (18) is formed over the components (col. 3, lines 5-18 and lines 51-52 and figure 2).

Roth et al also teach that a polishable layer (20) is deposited above the etch-stop layer (col. 4, lines 5-8).

Roth et al, teach that a polishing step is performed for planarizing the polishable layer at a point in time wherein the polish-stop layer is exposed using a polishing slurry in a chemical mechanical polishing (CMP) process (col. 4, lines 14-18, lines 38-41).

Roth et al, further teach that a portion of the stop layer is removed subsequent to the polishing step (col. 5, lines 10-11).

As to claim 2, Roth et al teach that the polish-stop layer polishes at a slower rate than the material to be polished (col. 3, lines 51-55). So, the polish-stop layer is more resistant to the polishing slurry compare to the polishable layer."

Responsive thereto, Applicant respectfully traverses this ground of rejection and Applicant asserts that the claims are not anticipated by Roth '117. Specifically, Applicant believes that Roth is misinterpreted by the Examiner in the comment quoted above that "Roth et al further teach that a portion of the stop layer is removed subsequent to the polishing step (col. 5, lines 10-11)." Additionally, in paragraph 10 of the Office Action the Examiner references Figs. 7-9 of Roth et al. These figures, and the specification described in these figures, likewise do not support the Examiner's position, as is next discussed.

With regard to the last limitation in amended independent claim 1, which states: "removing portions of said stop layer subsequent to said polishing step." this step is not taught by Roth. Specifically, with regard to the teachings of Roth, Applicant has submitted herewith copies of Figs. 1-11 of Roth that are shaded for ease of Applicant's explanation. With regard to Applicant's shaded figures, commencing with Figs. 2-6, as described in col. 3, line 51, an etch

stop layer 18 (shaded) is formed overlying a layer of material 16 that is deposited on top of components 14. Thereafter, with reference to Fig. 3, an etching process is undertaken to remove generally horizontal portions of the etch stop layer 18, such that sidewall portions of the stop layer 18 remain, as is described in col. 3, line 63 - col. 4, line 4. Thereafter, a layer 20 of polishable material is deposited as is depicted in Fig. 4 and described in col. 4, lines 5-14. Thereafter, as depicted in Fig. 5, a CMP step is used to remove portions of the polishable layer 20 down to the etch stop layer 18 (shaded), as described in col. 4, lines 14-20. As is next depicted in Fig. 6, further components, such as interconnects 22 are fabricated on top of the planarized surface as is described in col. 5, lines 61-68.

Therefore, it is clear that Roth et al Figs. 1-6 does not teach the removal of portions of the etch stop layer 18 (blue) subsequent to the CMP step, and the only step in which portions of the stop layer 18 are removed are depicted in Fig. 3 which is prior to the CMP step. This is opposite the contention of the Examiner that "Roth et al, further teach that a portion of the stop layer is removed subsequent to the polishing step (col. 5, lines 10-11)." *

With regard to the comment in Roth, col. 5, lines 10-11 referenced in the Office Action, it states:

"In Fig. 5, the etch stop layer is removed from the contact regions and remains only on sidewall areas."

Applicant submits that this comment of Roth is a statement describing the generalized state of Roth device after the planarization step depicted in Fig. 5. It is a general comment and it must be understood as follows:

"In Fig. 5 the device is depicted in which the etch stop layer is removed in the step depicted in Fig. 3 from the contact regions and remains only on sidewall areas." [Applicant additions underlined]

When this sentence (col. 5, lines 10-11) is interpreted as stated immediately above, it is entirely consistent with the figures and the remainder of the description of Roth et al. Conversely, if this sentence is interpreted as urged by the Examiner, it is inconsistent with the figures and the description provided in the specification, because no portion of the etch stop layer is taught in Roth to be removed subsequent to the CMP step.

With particular reference to Roth Figs. 7-9, and the description in col. 6, lines 5-50, it is seen that the polish stop layer 18 (shaded) is etched in Fig. 8 to the configuration depicted in Fig. 9. Thereafter, as depicted in Figs. 10 and 11, a CMP process is undertaken down to the level of

the polish stop layer 18 (see Fig. 11). Significantly, thereafter, Roth teaches nothing with regard to the removal of the polish stop layer 18 subsequent to the CMP step. Applicant therefore continues to assert that Roth fails to teach this limitation as set forth in varying ways in independent claims 1, 15 and 27.

Applicant therefore submits that Roth does not teach the limitation of claim 1 that portions of the stop layer are removed subsequent to the polishing step. Therefore, Roth does not anticipate the last of the limitations of amended independent claim 1.

With regard to dependent claims 2 and 3, Applicant asserts that they are allowable in that they depend from an allowable base claim.

In paragraphs 4, 5 and 6 of the Office Action claims 5-7,9-10,15,17-19, 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roth (5,272,117) as applied to claims 1-3 above, and further in view of Cheng et al (6,086,777), stating:

"As to claim 15, Roth et al discussed above in the paragraph No. 3 above and also teach that the planarizing or polishable layer (20) is deposited over the projected components (14) to cover the entire surface of the substrate (see figure 4).

So it would have been obvious that the depth of the polishable layer is greater than the projected height of the components.

Roth et al fail to teach explicitly that a polishing stop layer is directly upon the top surface of the components.

However, in a method of making interconnect, Cheng et al teach that a polishing stop layer (18) is deposited directly on the top surface of the components (14) for preventing conductive material from diffusing into the diffusion region or into the component regions (col. 5, lines 36-42).

Therefore, it would have been obvious to one ordinary skilled in the art at the time of claimed invention to combine Cheng et al's teaching into Roth et al's teaching for preventing conductive material from diffusing into the diffusion region or into the component regions as taught by Cheng et al.

As to claims 5-7 and 17-19, Cheng et al also disclose a polishing —stop layer of tantalum (18) having a thickness range from about 300 to about 500 angstroms (col. 5, lines 37-49).

As to claims 9-10 and 21-22, Cheng et al teach that a portion of the polish-stop layer using ion-etching process, wherein the etching gas comprises argon (col. 3, lines 64-col. 4, lines 3 and col. 5, lines 17-20)."

Responsive thereto, Applicant respectfully traverses this ground of rejection and asserts that the claims are patentable over Roth in view of Cheng as is next discussed.

With regard to amended independent claim 15, a first limitation is "depositing a polishing stop layer upon said components, with portions of said stop layer being deposited upon the top surface portions of said components;". A final limitation of claim 15 is "removing said portions of said stop layer that cover said top surface portions of said components." Applicant submits that neither Roth nor Cheng nor any combination of the teachings thereof render obvious these limitations.

Specifically, Roth and Cheng teach very different processes, the steps of which are not readily or obviously combinable. Specifically, Cheng lacks upwardly projecting components, and significantly, the etch stop layer 18 of Cheng is not removed from the top of the component 12, as described in the last limitation quoted above of claim 15. Cheng also fails to teach the limitation set forth in claim 15 of "wherein said CMP polishing step is conducted down to said portions of said stop layer that cover said top surface portion of said components," Roth likewise fails to teach a CMP step that is conducted down to a stop layer that covers the top surface of the components. As a result, Applicant submits that claim 15 sets forth limitations that are not obvious from the combined teachings of Roth and Cheng.

With regard to dependent claims 5-7, 9-10, Applicant notes that these claims are dependent, either directly or indirectly, upon amended independent claim 1, and based thereon, Applicant asserts that these claims are allowable.

Regarding dependent claims 17-19 and 21-22, Applicant notes that these claims are dependent, either directly or indirectly, from amended independent claim 15, and based thereon, Applicant asserts that these claims recite allowable subject matter.

In paragraph 7 of the Office Action claims 11-13, 23-25, 27, 29-31 and 33-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roth et al (5,272,117) in view of Cheng et al. (6,086,777) as applied to claims 5-7, 9-10, 15, 17-19, 21, 22 above, and further in view of Jaso et al (5,246,884), stating:

"Modified Roth et al discussed above in the paragraph No 6 above and also teach that the etch-stop or polish-stop layer could comprises diamond (col. 3, lines 51-58).

As to claims 12-13, 24-25, 29, 33, 36-37, Roth et al fail to teach that the polish-stop layer is diamond-like-carbon (DLC).

In a method of using an etch-stop or polish-stop layer, Jaso et al teach that diamond or diamond-like-carbon (DLC) can be used as an etch stop layer (col. 3, lines 24-28). Jaso et al also teach that the stop layer is removed by a reactive ion etching such as oxygen ashing process (col. 3, lines 53-55 and col. 4, lines 52-53).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to employ Jaso et al's teaching into Roth et al's method because both the diamond and diamond-like-carbon (DLC) are functionally equivalent as taught by Jaso et al.

As to claim 27, Roth et al teach that the first layer (16) is deposited to maintain the topography of the projected components (14) (col. 3, lines 24-35). So, it would have been obvious to have the deposited depth of the first layer smaller than the projected height of the components.

As to claims 11, 23 and 35, Roth et al teach that the etch-stop layer is polished at a slower rate than the polishable layer (col. 3, lines 52-54). Roth et al also teach that the exposed stop-layer is removed subsequent the polishing process (col. 5, lines 10-11).

As to claims 33 and 34, Cheng et al teach that a portion of the polish-stop layer using ion-etching process, wherein the etching gas comprises argon (col. 3, lines 64-col. 4, lines 3 and col. 5, lines 17-20)."

Applicant respectfully traverses the Examiner's comments in rejecting independent claim 27.

With regard to amended independent claim 27, it describes Applicant's invention as depicted in Figs. 7-13. Particularly, a first limitation within claim 27 is "depositing a first layer of material upon a substrate, wherein a projecting portion of said first layer of material is deposited on top of said components, and wherein said first layer is deposited to a depth that is less than a projecting height of said components;". Roth teaches that components 14 are covered by a first layer 16. However, Roth does not teach anything with regard to the thickness of the layer 16 in comparison to the height of the components 14. Particularly, Roth does not teach that the thickness of the layer 16 should be less than the height of the components 14, as is specifically set forth in amended independent claim 27. Additionally, Roth fails to teach the limitation of "depositing a polishable layer on top of said stop layer, wherein portions of said polishable layer are deposited on top of said portion of said stop layer that are deposited on top of said projecting portions of said first layer;". Rather, in Roth, as depicted in Figs. 2, 3 and 4, the portions of the stop layer 18 (shaded) that are deposited on top of the projecting portions of the first layer are removed (see Fig. 3) prior to the deposition of the polishable layer 20 on top of

the stop layer. Likewise, in Figs. 7-11 of Roth the portions of the stop layer 18 (blue) that were deposited on top of the projecting portions of the first layer are removed (see Fig. 9) prior to the deposition of the polishable layer 20 on top of the device.

With regard to Cheng, it does not teach the first limitation of claim 27 of "depositing a first layer of material upon said substrate, wherein a projecting portion of said first layer of material is deposited on top of said components, and wherein said first layer is deposited to a depth that is less than a projecting height of said components." For these reasons, Applicant submits that neither Roth nor Cheng, nor the combined teachings thereof, render obvious Applicant's invention as set forth in amended independent claim 27.

Additionally, focusing on the last limitation of claim 27, stating: "Removing said stop layer from said first layer." It is seen that this limitation is not taught by either Roth or Cheng or Jaso, or obvious from the combined teachings thereof. Particularly, in Roth, portions of the stop layer 18 (shaded) remain upon the first layer 16, as depicted in Figs. 4, 5 and 6 of Roth. In Cheng, portions of the stop layer 18 remain on top of the component 12 as shown in Figs. 5, 6, 7, etc. Specifically, Applicant asserts that Roth teaches nothing with regard to maintaining "the topography of the projected components 14 (col. 3, lines 24-35)." Rather, Roth does not focus at all on the height of the components 14, but is concerned with the creation of a layer above the components 14. Therefore, the actual thickness of the first layer is not discussed by Roth, and Roth provides no teaching that the thickness of the layer should be less than the height of the components.

With regard to dependent claims 11-13, 23-25, 29-31, and 33-37, Applicant asserts that these claims are allowable in that they depend, either directly or indirectly from an allowable amended independent claim 1, 15 or 27, as is discussed hereabove.

Lastly, with regard to the comment in this paragraph of the Office Action regarding claims 11, 23 and 35, Applicant traverses the comment that Roth teaches that the stop layer is removed subsequent to the polishing process (col. 5, lines 10-11), as discussed hereabove.

In paragraph 8 of the Office Action claims 8, 20 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roth et al (5,272,117) in view of Jaso et al (5,246,884) as applied to claims 1-4,15 and 27 above, and further in view of Martin et al (5,707,409), stating:

"Modified Roth et al discussed in the paragraph 7 above but fail to teach that the thickness of the DLC is in the range of approximately 200 Angstroms.

However, in a method of hard carbon coating, Martin et al teach that most preferable thickness of a DLC film is in the range of 100 to 5000 Angstroms. Martin et al also teach that it is expensive to make a thicker film and also becomes brittle and lose adhesion (col. 8, lines 20-31).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Martin et al's teaching into modified Roth et al's teaching in order to form a DLC film with lower thickness such as approximately 200 Angstroms because thicker film becomes relatively expensive, brittle and lose adhesion as taught by Martin et al."

Responsive thereto, Applicant respectfully traverses this ground of rejection and asserts that Martin fails to teach or render obvious the use of a DLC layer as an etch stop layer having a thickness in the range of approximately 200 Å. Particularly, Martin '407 teaches an abrasive article having a DLC layer is used as a top coat or as a layer that is located between the abrasive coating and a covering layer. Thus, the teachings of Martin basically amount to the simple indication that a DLC layer can be formed having a 200 Å thickness. There is no teaching in Martin that such a layer will act efficaciously as a polishing stop layer in a CMP process. Based thereon, Applicant submits that claims 8, 20 and 32 recite patentable subject matter. Additionally, Responsive thereto, Applicant notes that claims 8, 20 and 32 are dependent claims, and Applicant asserts that these dependent claims are allowable in that they depend, either directly or indirectly from an allowable independent base claim; that is, amended independent claim 1, 15 or 27.

In paragraph 9 of the Office Action claims 14, 26 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Roth et al (5,272,117) in view of Jaso et al (5,246884), as applied to claims 11-13, 23-25, 27, 29-31, 33-37 above, and further in view of Yang et al (6,153,116), stating:

"Modified Roth et al discussed above in the paragraph 6 but fail to teach that the end point of the CMP process is determined by monitoring a polishing motor current.

However, in a method of end point detection of a CMP process, Yang et al teach that it is conventional to monitor the polishing motor current in order to detect an end point of a CMP process (col. 3, lines 45-67).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Yang et al's teaching into modified Roth et al's

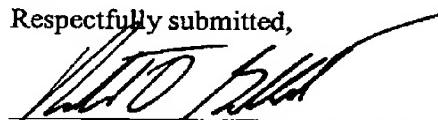
process for efficiently detecting the end point of the polishing process as taught by Yang et al."

Responsive thereto, Applicant notes that claims 14, 26 and 38 are dependent claims, and Applicant asserts that these dependent claims are allowable in that they depend, either directly or indirectly from an allowable independent base claim; that is, amended independent claim 1, 15 or 27.

In paragraph 10 of the Office Action the Examiner's response to Applicant prior arguments is provided. Applicant appreciates the Examiner's review of Applicant's prior arguments, however Applicant continues to assert, as set forth above, that Roth does not teach the removal of portions of the etch stop layer after a CMP step.

Having responded to all of the paragraphs of the Office Action, and having amended the claims accordingly, Applicant respectfully submits that the Application is now in condition for allowance. Applicant therefore respectfully requests that a Notice of Allowance be forthcoming at the Examiner's earliest opportunity. Should the Examiner have any questions or comments with regard to this amendment, a telephonic conference at the number set forth below is respectfully requested.

Respectfully submitted,



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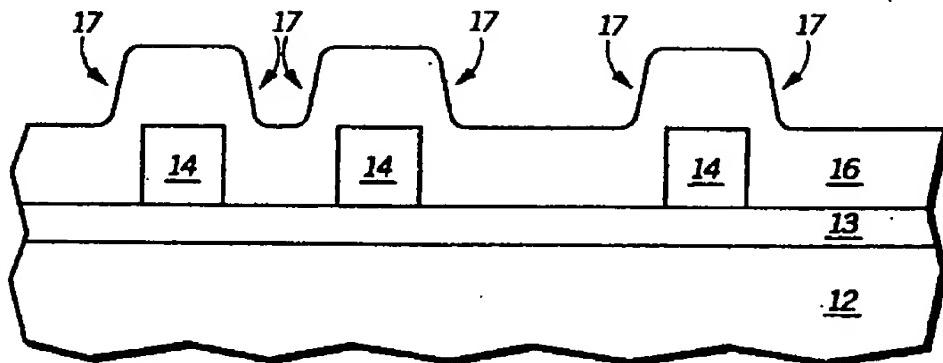


FIG.1

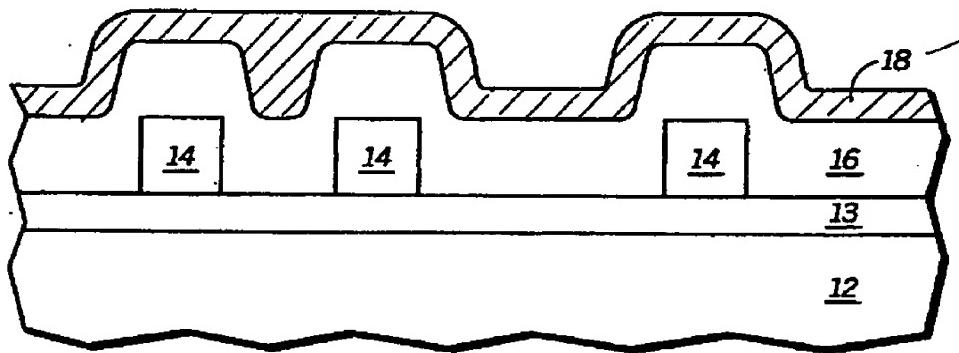


FIG.2

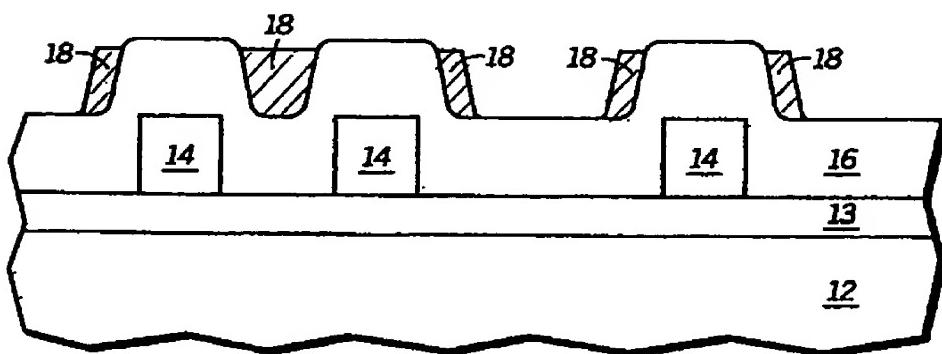


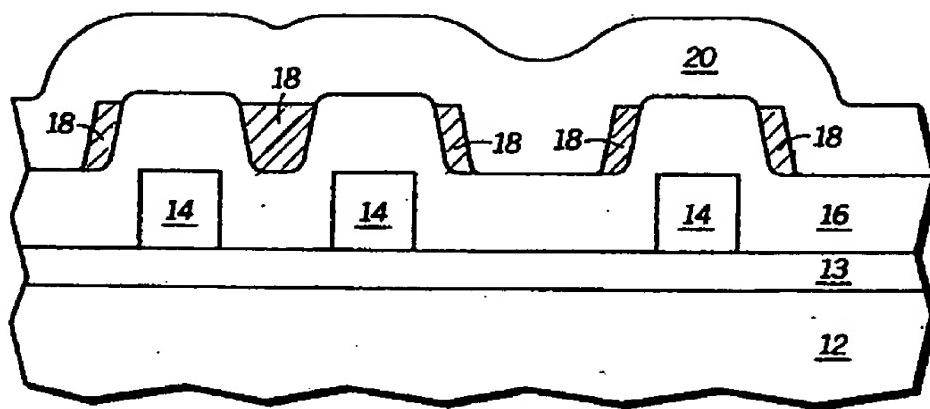
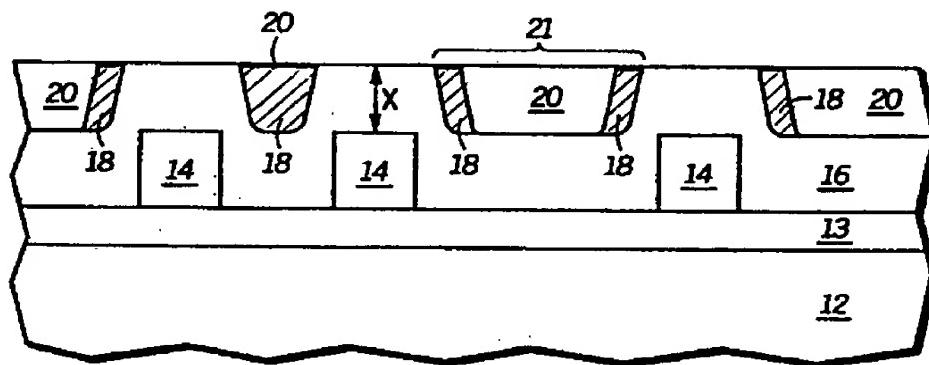
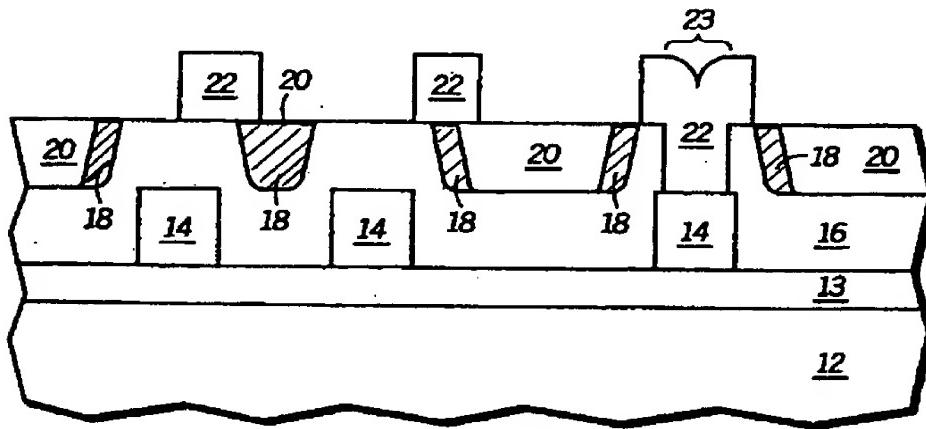
FIG.3

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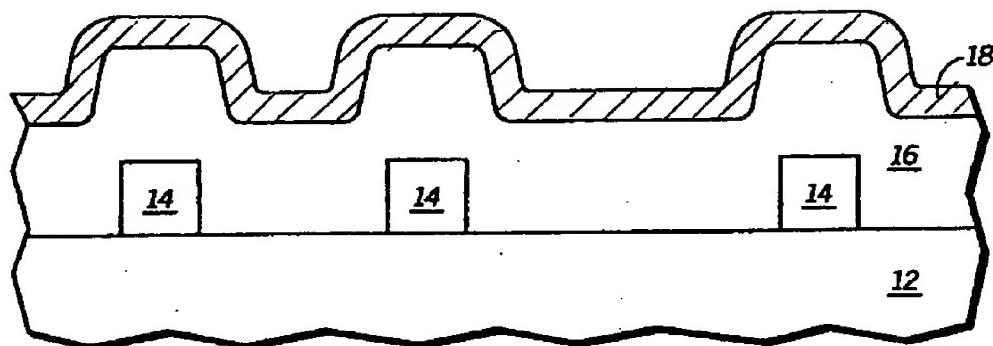
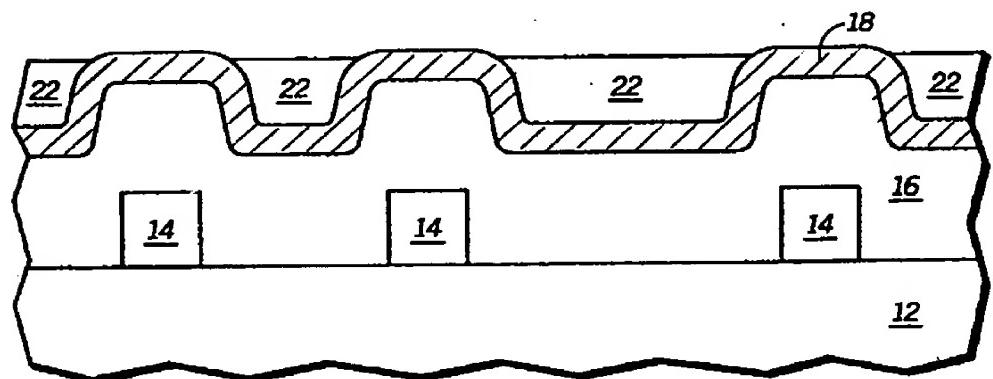
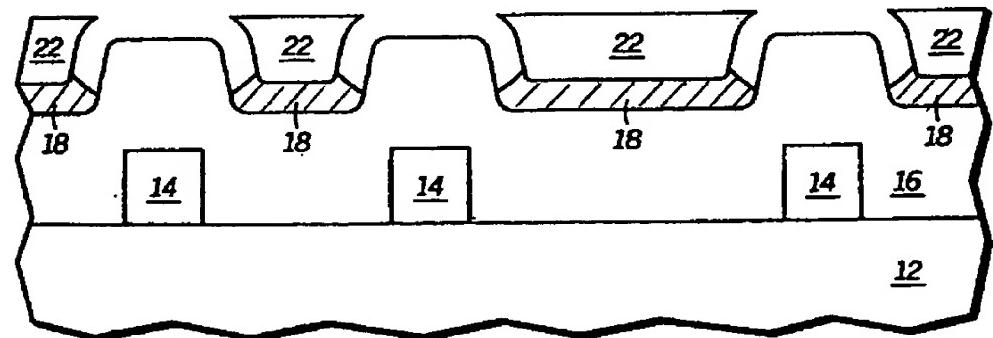
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***FIG. 4******FIG. 5******FIG. 6***

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5,272,117**FIG. 7****FIG. 8****FIG. 9**

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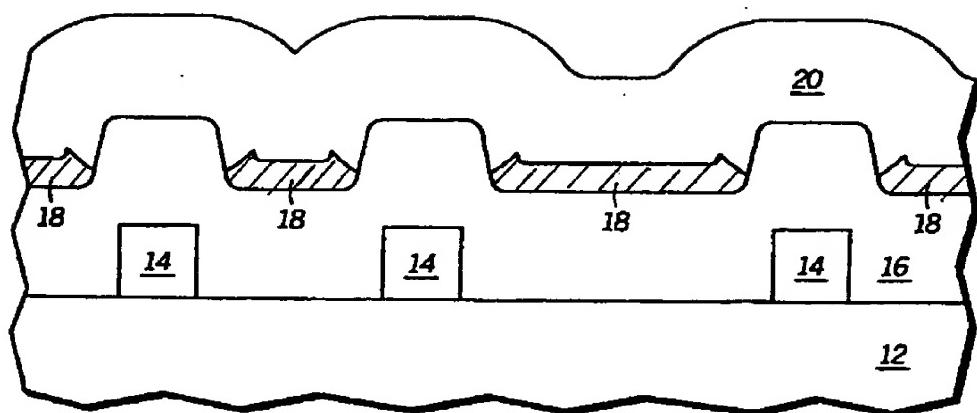


FIG. 10

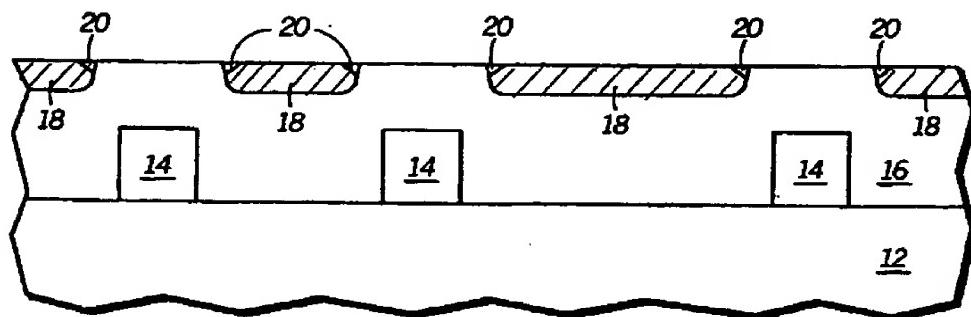


FIG. 11